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THE RELATIVE LENGTHS OF THE LARGE AND SMALL  
INTESTINES IN RODENTS.

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A few years ago Mr. John Gutberlet, working under the direction of one of us (Cockerell), made some interesting studies of the visceral anatomy of rodents, and among other things investigated the actual and relative lengths of the large and small intestines in different species, and different examples of the same species. The animals on which Mr. Gutberlet worked were kindly furnished by Mr. E. R. Warren, and the work is briefly referred to in *The Mammals of Colorado*, p. xx.

This year we have taken up the work afresh, and have considerably amplified and extended the earlier results. It has long been known that the length of the intestine in mammals varies greatly, and our facts therefore accord with those observed by others; but we have not been able to get over our surprise at the phenomenon. The alimentary canal is a part of the animal constantly in use, and essential for existence, and one would suppose that it would reach and be maintained at the optimum length. In man it is probable that the intestine is longer than necessary, but this is due to changes in food, resulting principally from the invention of cooking. In man, also, the superfluous parts of the canal cause disease and death, and except for the intervention of the surgeon, should be lessened through a process of selection.

It might be supposed that the differences observed were due to age, at least in part; but whenever we have found foetuses, the proportions of their intestines have agreed very closely with those of the mother. We have, however, only examined

foetuses of *Neotoma* and *Mus*. Parsons (Proc. Zool. Soc. Lond., 1898, p. 878) notes that the alimentary canal of foetal *Pedetes caffer* corresponds very accurately with that of its mother.

#### ***Mus musculus* L.**

All our material has been collected in Boulder. The maximum length of the small intestine is 49.8 cm., of the large 15; these measurements occurred in the same individual. About 40 cm. for the small and 9 for the large is more usual. The following figures represent the ratio of the large to the small intestine in the examples measured; the length of the small intestine is taken as 100, and that of the large is therefore expressed in percentages of it, decimals omitted. The numbers in parentheses refer to the number of individuals under each category. 15 (1); 17 (1); 18 (2); 19 (3); 20 (2); 21 (2); 22 (3); 23 (2); 25 (2); 26 (1); 27 (1); 30 (3); 31 (1); 33 (2); 34 (1). These figures suggest that larger numbers might give a distinctly bimodal curve.

In a female with ratio 100:34, a foetus showed 100:30. The following figures show the actual measurements of all the specimens having the small intestine over 40 or under 30 cm.; the first figure is that of the small, the second that of the large intestine. It certainly appears that the smaller mice have the large intestine proportionately somewhat longer (thus, the mice having the large intestine 30% or over the length of small, have small intestine of the following lengths, 28.9, 49.8, 39.4, 40.2, 33, 28, 28), but there is no regular correspondence. 45.2-8; 42.8-8; 49.8-15; 44-8.5; 45.5-8.8; 44.5-9; 42-9; 49.6-7; 43-9.5; 40.2-11.2; 40.2-12; 40.8-8.8. 28.9-9.9; 28-8.5; 28-9.

#### ***Epimys norvegicus* (Erxl.)**

All collected in Boulder. The ratio of the small to the large intestine is given in the same manner as above under *Mus*. 10 (1); 11 (1); 12 (1); 13 (5); 14 (2); 15 (2); 16 (2); 18 (2). Thus it appears that *Epimys norvegicus* differs conspicuously from *Mus musculus* in the proportions, although the extremes overlap; the series is also more compact, without any clear suggestion of a secondary mode.

The actual measurements (in cm.) are given in the same manner as those for *Mus*, for the individuals having the small intestine under 90 and over 100 cm.; 126-23; 125-8.5; 136-18; 114-13; 119-13; 111-14; 101.2-14; 103-17.8; 109-14.5; 104-14; 111.5-17; 72-12.6; 69-10.5. The last, giving the smallest measurements, is a male.

A well-marked example of the hooded rat, caught in Boulder, had a much longer large intestine than any of the normal rats, the measurements being 131-30. Is this racial, or an individual peculiarity?

#### ***Peromyscus boylii rowleyi* (Allen).**

Collected by E. R. Warren at Irwin's Ranch, Los Animas Co., Colorado. Ratios (given as under *Mus*): 58 (1); 59 (1); 60 (1); 64 (1); 67 (1); 69 (1). The small intestine varies from 21.3 to 25.5 cm.; the large from 14 to 15.2. There is thus little variation in the series, but probably material from other parts of the animal's range would show more. The proportions are entirely different from those of *Mus* and *Epimys*.

**Peromyscus maniculatus rufinus** (Merriam).

Collected by E. R. Warren at Medano Ranch, Costilla Co., Colorado, June 24, 1909. Ratios: 37 (2); 39 (1); 40 (1); 41 (1); 46 (1); 54 (1); 55 (1); 57 (1). The small intestine varies from 19 to 36 cm.; the large from 10 to 15. This is a more variable lot than the *rowleyi*, and the ratios are quite different. However, some *P. m. rufinus* collected at Boulder showed rather different figures, the actual measurements being 44.5-14; 35.8-14.21; 31-11. The variation here is still further away from *rowleyi*.

**Cratogeomys castanops** (Baird).

Mr. John Gutberlet has some interesting data on this species, which we hope he will eventually publish. It is the only one in which the large intestine was found to be longer than the small, the ratios (from Gutberlet's measurements) being: 103 (1); 125 (1); 126 (1); 140 (1); 143 (1); 146 (1). The small intestine varied from 34.3 to 47 cm.; the large from 48.3 to 61.

**Perodipus montanus** (Baird).

Collected by E. R. Warren at Medano Ranch and Hooper, Colorado. Ratios: 43 (1); 45 (1); 47 (1); 61 (1); 66 (1); 70 (1). Small intestine from 26.2 to 44 cm.; large from 17.4 to 21.2. A variable lot; the one with ratio 100 : 70 came from Medano Ranch. In this animal the right inferior lobe of the lung has no small pointed lobule beneath, such as is found in other genera examined by us.

The following measurements (in cm., the first figure the small intestine) relate to miscellaneous species, of which we possess only one or two specimens:

*Fiber zibethicus cinnamominus* Hollister (Boulder) . . 101-77.3.

*Neotoma cinerea orolestes* (Merriam) (Gregory Cañon) . 77-70.

*Citellus grammurus* (Say) (Boulder Cañon, 6000 ft., J. J. Blanchard) 146.5-58.

*Eutamias operarius* (Merriam) (Boulder Cañon) 51.3-25.4 and 65.7-36.1.

*Eutamias quadricittatus* (Say) (Howard, Colo., E. R. Warren) . 67.5-39.

The ratios for the chipmunks are nearly the same, all falling between 50 and 58.

*Onychomys melanophrys pallescens* Merriam. (Hooper, Colo., E. R. Warren) . . 27.8-7.5, and one measured by Gutberlet . . 26.7-8.9.

*Thomomys talpoides agrestis* Merriam. (Gutberlet's measurements) 35.6-33.

The high ratio (about 93) indicates some approach to the condition of *Cratogeomys*.

The smallest ratio known to us is 100 : 9 for *Dasyprocta aguti*, based on the measurements by Prof. R. Jones, referred to by Mivart and Muric, Proc. Zool. Soc. Lond., June, 1866. That for *D. cristata*, as reported by these authors, would be about 100 : 22.